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Applicant:		Stanley D. Echols
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DECLARATION OF RONALD RAHN

I, Ronald Rahn, hereby declare and state that the following facts are true to the best of my knowledge and belief based on information known to me personally to be true or upon reasonable belief as to the source and veracity of such information. I make this declaration with knowledge of the perjury laws of the United States and the penalty therefore, including the knowledge that the assertion of willfully false statements will aversely impact the validity and enforceability of any patent issuing from this application.

I am a co-inventor with Stanley D. Echols of the subject matter claimed in this application.

This patent application combines several features into a simplified method for measuring omni-directional germicidal radiation. Features include the following:

a) *An actinometric solution (a mixture of iodide and iodate) whose characteristics render it superior to any other actinometric solution for measuring germicidal radiation (Rahn, 1997).*

b) *Spherical actinometry vessels whose geometry allows the actinometric solution to respond to omnidirectional radiation from multiple light sources (Rahn, et. al., Sept. 1999)*

Prior to this invention, use of measurement vessels required knowledge of the vessels' cross-sectional area and volume. Hence, the volume of each vessel had to be measured, from which measurement the cross-sectional area could be calculated. Each vessel was then labeled and a record maintained of its size. This process was time-consuming, particularly when large numbers of vessels were being employed for spatial distribution studies. Also, the contents of each vessel had to be removed and placed in an optical cell of known size and shape, usually in the form of a cube, in order for the absorbance to be measured in a spectrophotometer. The resulting fluence calculation was based on the absorbance and the volume/cross-sectional area.

The present invention simplifies actinometry in the following two ways:

(1) It removes the necessity of transferring the contents of each vessel to a spectrophotometer for measuring the absorbance.
(2) It eliminates the need to measure and keep track of the size of each sphere.

With respect to item (1), previous patents have suggested that estimates of the degree of color change could be made in vessels of any geometry. Such estimates could be made by comparison with a set of calibrated solutions either by visual analysis or by densitometer measurements. However, I am aware of no proposal or demonstration, in the references cited by the examiner or in the literature that I am familiar with, that has been made that a spherical vessel could actually be used as an optical cell in a spectrophotometer or in a colorimeter. Such a demonstration would require that Beers Law be obeyed using a spherical cell, where the path length L in Beers Law is taken to be the diameter of the sphere.

Furthermore, it is not obvious that meaningful absorbance measurements could be made using a spherical, as opposed to a standard rectangular, optical cell. For example, no catalog that I am aware of dealing with optical cells has any that are spherical in shape. Nor are spectrophotometers designed to accommodate spherical cells. Accordingly, Dr. Echols and I modified a colorimeter to allow the spherical irradiation vessel to be used as a colorimetry vessel without measuring the size of the vessel or transferring the contents to a standard optical cell.

c) *A suitably adapted commercial colorimeter to measure directly the absorbance of spherical vessels containing actinometric solution following their exposure to UV radiation.*

We have shown that the absorbance of a spherical cell as measured in an appropriately modified colorimeter follows Beers Law. The modification utilizes an exit aperture proximal the spherical actinometer with light from the colorimeter source directed along the diameter of the actinometer vessel used as an optical cell.

As I stated in the Patent Application, when absorbance measurements are made at 352 nm in a spectrophotometer using a rectangular optical cell, the fluence is calculated using the following equation:

Fluence (mJ/cm2) = 23 x Absorbance (352 nm) x 4/3 r x1/L

Here, the constant 23 is specific for this wavelength (352 nm), r is the diameter of the spherical vessel and L is the path length of the optical cell, nominally 1 cm. However, if absorbance measurements are made at 420 nm in a colorimeter using the spherical vessel as an optical cell, the following equation holds:

Fluence (mJ/cm2) = 160 x Absorbance (420 nm) x 2/3

This equation derives from the one above by multiplying the constant 23 by the ratio of the molar absorbance coefficient at 352 nm divided by the one at 420 nm. Because L now is equal to 2r, the size dependence cancels out and the fluence is independent of the size of the sphere. An enormous advantage is thus obtained because all spherical vessels can be considered to be the same, eliminating the need to keep track of each vessel in accordance with its size. Hence, spatial distribution studies can be easily carried out using many spheres, which are cheaply made and easily measured with the adapted colorimeter.

My research validated the similarity of the average of a series of fluence measurements made by either transferring the contents of the irradiated sphere to a spectrophotometer for measuring the 352 nm absorbance, or by measuring directly in a colorimeter at 420 nm. The spheres ranged in size from 0.676 to 1.204 in diameter. In both cases, the average fluence is 82 mJ/cm2.

Neither the patents cited as references by the examiner, nor my prior papers suggested that such a result could be obtained when a spherical vessel was used as both the irradiance vessel and the optical cell for a colorimeter.

Signed,

Ronald Rahn

Ronald Rahn

Date: September 23, 2003

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